

## WHAT CAN ECONOMICS OFFER EMERGENCY SERVICES?

### ABOUT THESE PROJECTS

This is an overview of the *Economics and strategic decisions* cluster of Bushfire and Natural Hazards CRC research projects.

This cluster has four linked studies:

- 1. Decision support system for assessment of policy and planning investment options** – Prof Holger Maier, Dr Aaron Zecchin, Emeritus Prof Graeme Dandy, Jeffery Newman, Graeme Riddell, Charles Newland, University of Adelaide; A/Prof Hedwig van Delden, Research Institute for Knowledge Systems, The Netherlands. Contact [holger.maier@adelaide.edu.au](mailto:holger.maier@adelaide.edu.au)
- 2. Economics of natural hazards** – Prof David Pannell, A/Prof Atakelty Hailu,

A/Prof Michael Burton, Dr Fiona Gibson, Dr Veronique Florec, Dr Abbie Rogers, University of Western Australia. Contact [david.pannell@uwa.edu.au](mailto:david.pannell@uwa.edu.au)

- 3. Mapping and understanding bushfire and natural hazard vulnerability and risks at the institutional scale** – Prof Roger Jones, Celeste Young, Dr John Symons, Prof Peter Sheehan, Prof Bruce Rasmussen, Victoria University. Contact [roger.jones@vu.edu.au](mailto:roger.jones@vu.edu.au)
- 4. Pre-disaster multi-hazard damage and economic loss estimation model** – Prof Mehmet Ulubasoglu, Dr Prasad Bhattacharya, Dr Habibur Rahman, Deakin University; Prof Abbas Rajabifard, A/Prof Nelson Lam, Dr Mohsen

Kalantari, Dr Benny Chen, Dr Katie Potts, Anggraini Dewi, University of Melbourne; Dr Peeranan Towashiraporn, Asia Disaster Preparedness Centre. Contact [mehmet.ulubasoglu@deakin.edu.au](mailto:mehmet.ulubasoglu@deakin.edu.au)

### CONTEXT

A better understanding of the economic costs of disasters and their risks, and the risk-reducing benefits of mitigation, can build a more compelling case that improves the likelihood of mitigation options being resourced and implemented. This cluster of research projects focuses on developing the tools required to undertake sound analysis of the costs and benefits of different disaster risk reduction strategies.

## DECISION SUPPORT SYSTEM FOR ASSESSMENT OF POLICY AND PLANNING INVESTMENT OPTIONS

### BACKGROUND

To allow policy and decision-makers to make better long-term decisions with regard to mitigation and risk reduction strategies, an evidence base is required that enables decisions to be justified on a rational basis with the best available information. Currently, there are no tools that allow for a comparison of different hazards and their mitigation options, while also taking into account long-term planning. This study is developing decision support systems in the form of software tools that contain integrated models for the assessment of natural hazard mitigation options. The decision support systems can take into account future changes in demographics, land use, economics and climate, allowing policy makers to better understand the drivers of risk and the impact of their policies on the risk profile now and into the future.



▲ Above: RESEARCHER GRAEME RIDDELL SHOWS SOUTH AUSTRALIAN END USERS ASPECTS OF THE DECISION SUPPORT SYSTEM. PHOTO: TIM ALLAN

## RESEARCH ACTIVITY

The team has been developing a generic approach to assessing the long-term impacts of mitigation options on multiple hazards. This approach is then applied to a series of case studies to investigate the effectiveness of policy and planning investment options for optimal mitigation of natural hazards. The case studies comprise three separate locations – Adelaide, Melbourne and Tasmania – with each location looking at a range of hazards and their mitigation options over time, allowing emergency managers and

planners to assess the dollar costs of the impacts of mitigation decisions.

For each case study, the tool will be able to analyse areas of risk both now and into the future, test different types of risk reduction options, identify mitigation portfolios that provide the best outcomes for a given budget, and consider single or multiple types of risk reduction options.

## RESEARCH OUTCOMES

The decision support system case study for Adelaide is nearing completion. In consultation with end users, the system incorporates hazard

modelling of flooding, coastal inundation, earthquake, bushfire and heatwave. Expected impacts of these hazards have been modelled from 2015 to 2050 with an annual time step, showing the change in risks. Data from 2015 were used as a baseline to allow comparison with future impacts. Next steps will allow for the ability to test the impact of different mitigation and risk reduction measures across the different hazards under different long-term socio-economic and climate drivers.

Work on the Melbourne and Tasmanian case studies is ongoing, with end users advising on data collection and methodologies.

# ECONOMICS OF NATURAL HAZARDS

## BACKGROUND

This study tackles from an economics perspective issues relating to non-financial benefit estimation, risk analysis and development of decision-making frameworks that would help deliver value for money from public investments in natural hazard management. It has a broad scope in terms of natural hazards, including fires, earthquakes, floods, cyclones and tsunamis.

## RESEARCH ACTIVITY

The project has two main components:

- Estimate the non-financial benefits – an innovative tool is being developed for efficiently generating estimates of dollar values for non-financial benefits. The aim is to develop a tool that people with only a moderate knowledge of economics are able to use, and that people with no economics knowledge can learn from.
- Integrated economic analysis of management and policy – this involves the integration of technical, social, biophysical and policy information within an economics framework. Two case studies are being undertaken: with the first investigating flood management options in Adelaide, accounting for tangible and intangible impacts from floods and management, and the second is investigating prescribed burning options in private land in the Mount Lofty Ranges, South Australia.

Additionally, the project will develop guidelines for sound economic analysis, which includes an accessible and understandable guide to undertaking economic analysis of natural hazard management and policy.



▲ Above: A CASE STUDY IS INVESTIGATING MITIGATION OPTIONS FOR FLOOD MANAGEMENT IN ADELAIDE. PHOTO: SOUTH AUSTRALIA SES

## RESEARCH OUTCOMES

A case study on mitigation options for flood management for the Brown Hill and Keswick catchments in Adelaide has been completed, focusing on a set of flood mitigation options that are currently under consideration following a public consultation. Previous analysis by a third party had suggested that the benefit-cost ratios appear unfavourable. However, this previous analysis did not include intangible values (i.e. perceived values of public amenity, environmental benefit, health). The case study provides estimates that show how the understanding of the costs and benefits of mitigation options (investments in creek capacity upgrades, river diversions and detention dams) would change with the inclusion of intangible values to account for the health, environmental and social impacts of floods. These mitigation works would substantially reduce flood damage resulting from a flood with a one-in-a-hundred-year average return interval.

The second case study is currently being undertaken exploring the costs and benefits of

prescribed burning in private land in the Mount Lofty Ranges. At present, there is a coordinated approach to prescribed burning in public land in the region, but there is no policy or mandate for private landowners to prescribe burn on their properties. Private land constitutes a large proportion of the Mount Lofty Ranges, and fuel levels in private properties may significantly influence overall fire risk levels for the region. However, little is known about the costs and the benefits of prescribed burning in private land and land management agencies need this information to assess whether extending the prescribed burning mandate to private land would generate benefits in excess of the costs.

A literature review has also been completed on non-market valuation of natural hazards. The review found that there is scope to use willingness-to-pay estimates from existing studies, through benefit transfer, for some of the values affected by natural disasters. For some types of impacts, existing evidence is likely to be sufficient to support benefit transfer, while for others, additional studies are needed to fill information gaps.



# MAPPING AND UNDERSTANDING BUSHFIRE AND NATURAL HAZARD VULNERABILITY AND RISKS AT THE INSTITUTIONAL SCALE



▲ **Above:** RESEARCH HAS FOUND THAT RURAL AREAS IN VICTORIA ARE AFFECTED MORE ECONOMICALLY BY FLOODS AND BUSHFIRES THAN METROPOLITAN AREAS. PHOTO: COUNTRY FIRE AUTHORITY

## BACKGROUND

Current federal government spending on natural disaster response is more than 20 times the spending on preparedness. While the spending mismatch between response and preparedness is well understood, potential deficits in important social and environmental values are also faced. This study maps a broad range of economic, social and environmental values, and relating them to natural hazards within Victoria and explores them through the lens of risk ownership and vulnerability.

## RESEARCH ACTIVITY

A mapping platform and spatial maps of values at risk were produced for a Victorian case study, though the concept has national relevance. A desktop review was undertaken on how risk ownership is currently being allocated, followed by workshops with end users in Victoria, New South Wales, South Australia and Tasmania. The workshops explored, through a series of structured scenario exercises, how values and risk ownership are currently understood in relation to decision making. They also explored the best use of the mapping platform.

Risk ownership was investigated through who 'owns' these values, how they own them and what happens to those values and their associated ownership across different temporal and geographical scales. Risk owners were identified through ownership of assets (values at risk) and responsibility for activities that manage risk. A process-based framework to support better application of risk ownership based upon this work is currently being finalised in collaboration with end users.

## RESEARCH OUTCOMES

Institutional maps of risk ownership were constructed following the desktop review and workshops to provide an insight into the current balance of ownership delegations. These conceptual maps examining risk ownership related to strategic management of natural hazard risk prior to and following events.

Both the workshops and maps suggest that risk ownership distribution is uneven across the three areas assessed for the different major institutions: local, state and federal government; the community, industry and business; and boundary organisations. State government and local government had the largest allocation of ownership of

## END USER STATEMENT

The outcomes from these projects can help end users in a variety of ways, whether they be single hazard response agencies wanting to quantify and understand risks across their one hazard, central planning agencies who need to understand these same risks for multiple hazards across their entire jurisdiction, or local councils or other authorities who want to understand the nature and prioritise mitigation for a certain town or locality.

It is hoped that this research can help answer questions that can be very complicated in a multi-stakeholder environment, questions such as 'who is responsible for risks and mitigation?', 'who is accountable for delivery of mitigation?' and 'who pays for mitigation?'

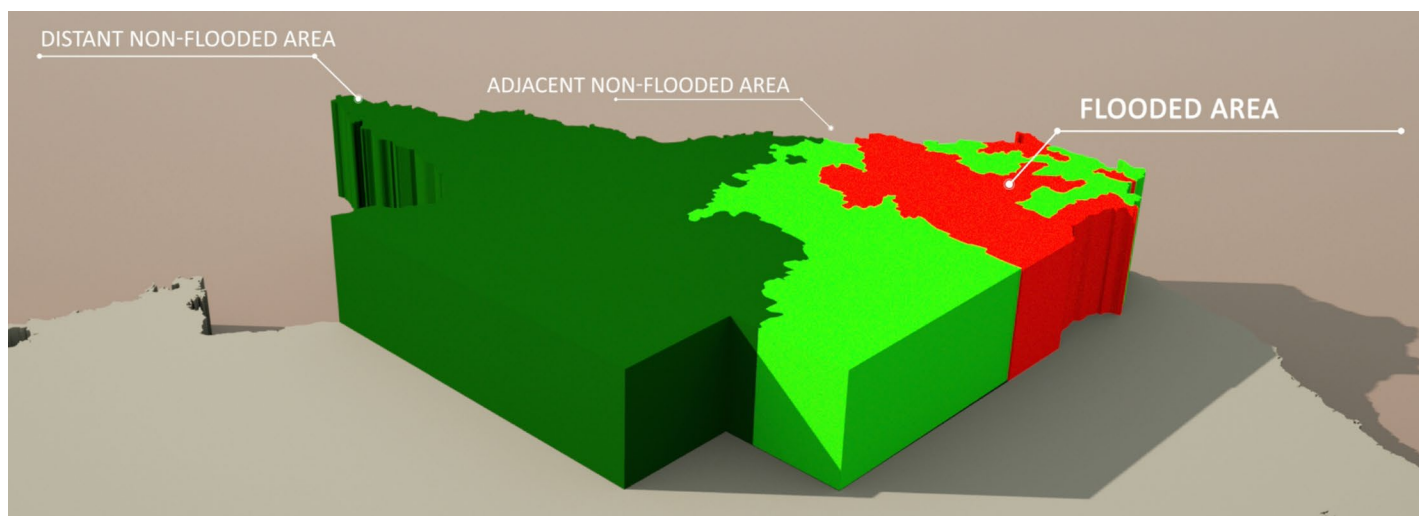
– **Ed Pikusa, Principal Flood Management Officer, Department of Environment, Water and Natural Resources, South Australia**

risk and consequences, and risk actions; whereas ownership of values at risk, covering tangible assets such as built infrastructure, and intangible assets such as connectivity, was more evenly spread between institutions (Young *et al.*, 2016).

Development of the platform and spatial maps has been completed. Consultation with end users about its potential future use settled on its application as a research tool to formulate and test questions. End users also identified sense-making of data – to better understand and use their existing data and mapping tools in support of strategic decision making – as a key need.

A report based on the values-at-risk maps, describes the economic geography of vulnerability to bushfire and flood in Victoria. Industries and localities with the highest vulnerability and lowest economic diversity were identified, based on the exposure of 2011 output data to historical hazards. Vulnerability is high in some sectors (e.g., agriculture) and some regions, mainly rural areas, where up to 50% of annual output can be vulnerable. Metropolitan areas are largely insensitive to these risks and peri-urban areas contain some vulnerable areas.

# PRE-DISASTER MULTI-HAZARD DAMAGE AND ECONOMIC LOSS ESTIMATION MODEL



▲ Above: AREAS OF QUEENSLAND THAT WERE IMPACTED BY THE 2010-2011 FLOODS.

## BACKGROUND

This project is investigating the economic impact of natural disasters on the Australian economy, across sectors such as agriculture, forestry and fishing, mining, manufacturing, utilities, construction, retail trade, transport and health care. Economic impacts can often be overlooked in management planning as the effects are not always immediate. A substantial problem is the inability to estimate the full economic impact of natural hazards, considering all the affected sections of the economy. This effort should take into account not only the primary impacts of natural disasters, but also secondary impact due to economic loss.

The overall objective of this project is to build a scenario-based pre-disaster multi-hazard damage and economic loss estimation model to support decision makers in reducing disaster risks at the sectoral level.

## RESEARCH ACTIVITY

The study is using selected emergency events (2010-2011 Queensland floods, 2009 Black Saturday bushfires) to present the impact of these natural disasters on different sectors of the economy. This will include how the event impacted over time, illustrating how events can ripple through the broader economy.

A case study has been undertaken on the Queensland floods, investigating the impact of the event on the different sectors of the economy. The goal is to estimate the effect of the floods on an individuals' income by the sector they are employed in, to identify the sectors that are vulnerable to natural disasters, the sectors that are beneficiaries of natural disasters, and the sectors that are unlikely to be affected by natural disasters. The outcome of this research will be a ranked list of economic sectors according to the impact of the disaster on the sectors. This will provide policy makers with the evidence they desire to minimise the potential negative effects of natural disasters at the sectoral level.

## RESEARCH OUTCOMES

Using data from the Australian Bureau of Statistics, the team has compared income variation from 2006 to 2011 of the flood-affected individuals in Queensland with unaffected individuals to detect any differences in income by employment type as a result of the flood. Preliminary results indicate a range of outcomes - some sectors experienced no income difference as a result of the floods, while three sectors

were impacted negatively (retail trade, business support services, and accommodation and food services), and two were impacted positively (education and training, and health care).

## FURTHER READING

Maier R, van Delden H, Riddell G, Newman P, Zecchin A, Dandy G, Newland C (2016). Natural hazard mitigation decision support system: annual project report 2015-2016, Bushfire and Natural Hazards CRC.

Pannell D, Hailu A, Gibson F, Florec V, Chalak M, Rogers A (2016). Economics of natural hazards: annual project report 2015-2016, Bushfire and Natural Hazards CRC.

Ulubasoglu M, Rajabifard A (2016). Pre-disaster multi-hazard damage and economic loss estimation model: annual project report 2015-2016, Bushfire and Natural Hazards CRC.

Young C, Symons J, Jones R (2016). Institutional maps of risk ownership for strategic decision making, Bushfire and Natural Hazards CRC.

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*Hazard Notes* are prepared from available research at the time of publication to encourage discussion and debate. The contents of *Hazard Notes* do not necessarily represent the views, policies, practises or positions of any of the individual agencies or organisations who are stakeholders of the Bushfire and Natural Hazards CRC.

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